Notebook Series -- Notebooks by Edison
Notebook, N-17-06-08

This notebook was used by Edison in June 1917 to record research performed for the U.S. Navy during World War I. This work was probably done in connection with his attempts at aiding submarine detection. Included are cursory specifications for a group of devices, numbered U1 through U21 (and referred to as "galvanometers" in later notebooks such as N-17-06-28), to be used in measuring amplified sound. Also included are notes on a series of experiments with possible amplifiers for detecting sounds. Several notes indicate that Edison was assisted in these experiments by Jerry T. Chesler and that a "Telephone Audion Expert" was also consulted. One entry involving a failed amplifier contains the notation that "This is Hell—War is Hell—The soul of some German must have got into the audion bulbs." The experiments are continued in N-17-06-14.1. Inserted into the book is one loose page of notes, annotated by an unidentified laboratory employee, repeating some of the instrument specifications. The front cover is labeled "U2." The pages are unnumbered. Approximately 65 pages have been used.

17-06

U1 — 10 needles Stretch 1/2 gram 14/32 total length fibre, Rubber holder / Stop—

U2 - 10 needles Stretch 1/2 gram 9/32 total length fibre - Stop — Rubber holder

U3 5 needles - stretch 1/2 gram - 9/32 total length fibre, Stop - Rubber holder.

U4 18 needles

U5 2 needles, 1/2" stretch 9/32 total length fibre, Stop — Rubber holder
Needles Twice as long 1 1/2" about

U6 2 needles 3/16 long - stretch 1/2" 9/32 fibre, Rubber holder - Stop —

U7 10 3/16 mag 005 7/32 mirror
Rubber holder — turned out
1/32 deep 9/32 fibre, stopped —

U8 = 2 magnets 3/8 long 7/32 mirror Metal
holder — this turned out 1/32 deep, these needles
1/4 less in length than U5.

U9 — 10 needles 1/2" stretch
9/32 fibre, Rubber, stop

U10 — 10 mag 3/16 — 7/32 mirror
turned out Rubber holder 1/32 deep
hung on a reg silk thread of many
fibres — not assembled right, fibre twisted
so off scale

U11 Reg rubber 5 needles – Mirror
□ 1/16 wide 7/32 long 9/32 fibre

U12 5 needles – 9/32 –
Has ring magnet in it
1/16 thick. 1/4 long

U18 – 5 needles 7/32
mirror 005 – needles 005
thick – 3/16 long

good one
used
2 weeks

U17 7/32 mirror 005 glass 5 magnets
005

U16 3/16 mirror 005 glass 4 magnets
005 thick

U13 4/32 fibre length
10 needles

U14 6/32 length fibre
10 needles-

U15- 2/32 fibre length
10 needles-

U19- 3/16 mirror 5 needles .005
fibre stretched with 1 gram

U20 - 3/16 mirror .005, 5 needles .005
stretched with 2 grams

U21 3/16 kernor .005 – 5 magnets
.005 – stretched with
1/2 grain – fiber length
5/32

Uq- Mica wing - steel bar over
diameter $15\frac{1}{4}$ = 98 milamp
swing 1 3/4 — 6 Vibs
phone 1/2 away - Very dead
beat taps metallic when
Key open —

phonoplex 3/4" swing -

This experiment shows that
for sensitiveness coil should
have the smallest Vane or
air resistance

Very steady - nearly dead beat

U8 = swing $3\frac{1}{2}$ 6 vibs

milamp - 58 phonoplex 1"

phonoplex $1\frac{1}{2}$ swing $\frac{1}{2}$"

Note this should be more sensitive than U5 yet is less sensitive probably due to Eddy Current in the metal holder U5 having Rubber

U7 = 6 Vibro-phonaplex 1"
swing 9 1/2" 59 mil amp
long time to come to zero
when key opened, somewhat
sensitive to shock -

phonaplex 1 1/2 swing 2 1/4

U10 - 6 Vibs - phonoplex 1/2

7 1/2" swing seems to vibrate several times faster than 6 Vibs

176 milamp - probably a multiple judging from the amperes on director

It really is - a multiple

When director current opened we get 4 1/2 swing -

Now phonoplex 1"

Swing 1/4 =

Not promising

U11 - If fairly stable -
stays Zero + Vibration
by far scarcely any
when Director 6 Vibs
sec
probably to do light
that Magnet holds it

Very sliaty at 18
Vibs
Light is very poor
Can scarcely see it.
when 6" swing

6 Vibs second
U11 — Swing 10" phono 1"
milliamps 35
phono 1½ Swing 2½"
phono 2" 3/4" swing —
phono 3" nothing —

24½ Reed 18 Vibs sec
Phonoplex 1" 6½ swing —
300 milliamperes —

Phonoplex 1½ 2 3/4 Swing
Phonoplex 2" 2 3/4 "
" 3" 2 1/4 "
Phonoplex 5" 1½ "
Phonoplex 7" 3/4 "

Think of mirror turned other way gives a triple's line

Now

other way

as area is $\frac{1}{3}$ rd

Its quiet at 3 Vibs needed already + slow

U11 Continued

WE set Reed at $29\frac{1}{2}$"

12 Vibs per second —

~~Reed~~ Phonoplex 1"

Swing 8"

Mil amp 150 —

Phonoplex 2" 3/4 — to 1"

Now 3 Vibs Reed

Phonoplex 1"

Swing $3\frac{1}{2}$ no current

no steel magnet — no

Tuning

Phonoplex 2"

Swing 1/4" to 1/2"

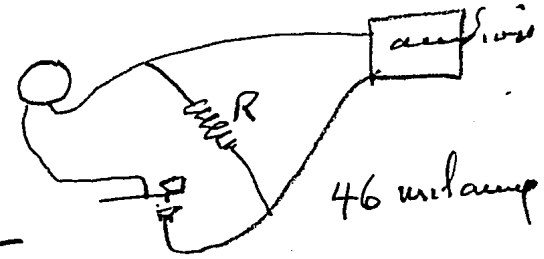
But not fully tuned but reads

Zero

U12 – phonoplex 1"
Sloping 2 1/2" 41 melamp
phonoplex 1 1/2 3/4" sloping
" 2" nothing

18 Vibs – 24 1/2 Reed
Phonoplex 1"
Cant get anything
NG

June 8 1917
Experiments with Reg
Mirror Outfit No 3 U
Rubber Bobbin - 5 A. 350
ohms -



6 Volts -

R has 7 ohms, phonoplex
30" away - swing 4"

Now R1Q 36" away - 5" swing
Tried 42" - [redacted] - Something
Changed had to make Res. ohmic
several hundred ohms

again 36" phonoplex away
Res 700 ohms Swing
4"

24" away Long Bell no
deaphin - Swing
4" (Res 5000 ohms)

Opening Mirror End current
1 min dont build up

Something wrong
somewhere —

5

1

It was out of time — gives at 24" away of phonoplex when tuned good 8" swing steady 50 milamp —

100 ohm shunt - 5" throw

Note = Phenomenon when Res of shunt is increased the swing come way down to 2 or 3 inches — some inductance phenomenon going on here —

Removing shunt altogether swing goes to 14 meter —

Using Quad Res-box 3300 ohm shunt 2" swing —
100 ohm 7 meter —
Opening shunt altogether 14 meter —

With Paul Resistance box
100 ohm w shunt 4" swing
1000 4½

2000	nothing
3000	1 1/2
4000	4
5000	5
6000	5 3/4
7000	6 1/2
8000	7 3/4
9000	8
10000	9 1/2

Far as Can go —

When Paul Res to Ground

goes to 14" swing

Paul acts

We now put phonoplex

30" away 4000 ohm in
~~Pa~~ Wheatstone Queens
Swing $3\frac{1}{4}$"

Now 36" away Swing $2\frac{1}{2}$

Now 48 — nothing
Even with shunt off -

Now 42" away nothing

Now 36" " Now 8"
with 4000 ohm shunt.
after a little while goes to
$14\frac{1}{2}$ @ 15" & close key &
let it vibrate. after

6 Vibs — 47 mil amp

Soldering phonoplex

wires — ~~[illegible]~~ swing

4"

We now make amperes on

audion lamp calling

right, & solder the

6000 ~~[illegible]~~, shunt an audion

with Wheatstone 4000

ohms

Trouble again can't

get at phonoplex 24"

away —

Now find shaking

one of the Silver Cell
Cells connected N to grid
at junction needle
violently - possibly
electrodes Crow
or silver tree formed in
cell —
We substitute 2
Dry small 2½ × 3"
Leclanche, specially made
for Cardion work —
No changes made
work

I note that with 100 000 ohm resistance embedded for the 600 000 we got same trouble as phone in Mirror Cat I hear snapping loud several while sound without moving mirror than another which happens to strike the swing might well nearly throw stuffed

If I stop read it does same thing — while stopped if I vibrate key at Mirror it gives continuous knocks in phone after a while + Mirror keeps 66 scale —

One Bug found

Read alone with Rec in place of phonoplex can hear it continuously in phone at Mirror when phonoplex on it

strong when phonoplex off + Resistance on Cun hear every V.G of need but not so strong –

Mirror just wider a little, as one probably neutralizes the other –

We have probably found the Bug – It is this

The reed Magnet creates a powerful field, when the phonoplex is close to reed it generates the waves + we can Tune for them, but when phonoplex is placed a special distance away - The more wider field of the Reed Magnet predominates, as this occurrence of the setting of break spring lags + there will be a point where phonoplex wave is neutralized by Reed field wave

When phonoplex is suppressed then the tuning must go from 47 mil amp to 63 mil amperes -

We now are trying scheme to obviate this defect of ~~LOE~~ head plainly the make + break of reed magnet by phone at receiver from rebound of contact opening it sounds like a click -

June 9 1917

Every experiment we have tried so far on the Mirror resonance has been entirely misleading as to sensibility of the Mirror compared with the Telephone,

The trouble is due to the powerful induction magnetic field produced by the Reed magnet,

It interfered 1st because the Contact point was not in relation with the Time on the Bell phone waves

2nd When the Bell was close to Reed it was strong the big field of the Reed magnet overturning it

When the bell was set away the Reed Mag neutralized + we get nothing if bell is drawn further away the Reed magnet predominates —

Even of wire experiments where Connected 5½ inch up the trench End + diaphrm of bell 5 ft away is vibrated by the field of Big Reed magnet extending that distance,

WE now put 42½ Reed in Milners room - + extend a fine wire into Music room Connect Reed with one End 6" from Clamp + the other End to a long Bell phone - whose Current goes to audition (4 stage) -

The amplitudes of reed at

		Strength
$5\frac{1}{2}$ from base	006	36
5	005	25
$4\frac{1}{2}$	004	16
4	003	9
$3\frac{1}{2}$	002	4
3	0015	2.25
$2\frac{1}{2}$	001	1

Reed now making 1/2 amplitude wire 22 ft 6" long set at $5\frac{1}{2}$" from clamp — wire fastened to Bell diaphram With break wheel in circuit and another phone in same circuit hear the Reed faintly —

Steel Mag Kept on directly
about 15" above Mirror

Coil of Mirror Set N+S.

We now see if we can tune for
it on Mirror with or without
break wheel in operation —

Wheel running very heavy
were 5½" on reed
fairly — We get 1" throw
on U3 with 65.8 Ma amps
with Wheel Cut out phone in
at Mirror 6½ phone Cut out
7¼ mah — Very heavy
nothing when Wheel
stops —

For fear the Reed Magnet
may project lines 21 ft
we lengthen wire to 38 ft ~~ft~~
& ~~try~~ it again — Say of course about
same as with 21 ft

Get throw of 4½" + 6" by fine tuning with wheel clapped + 3/4" wheel ~~also~~ running — Jenny says very faint when wheel running — now 65.3

Put on Audion — Mirror shunted 1 ohm 14" throw —

We now ~~show~~ remove this shunt + put it at string phone circuit —
Shunted 1/10 ohm 4" throw
Jenny not sure of Resistance will try the porcelain spiral wire

Spirals NG - Put in Queen
Bridge 10 amp - get 2"
throw + hear big strong
waves impact on chain.

65.3 to 67.1 turned it out

All these Experiments
NG - We found that
Audion will not
amply low rate vibrations
like 6 per second,
But found that of a
break wheel 3 to 400
second was put in

current it would start to amplify — but there is a current from the wheel (thermo) which is very loud on phone at Winton. yet Merron pays no attention to it but when phonograph & 4 iron pieces removed past Bellwether and dropping it responded swinging 14" at 1" away —

When wheel was shunted
with 500 ohms screw
came down to 4"
When shunt removed
+ water put on wheel
it reduced 11 mm of
Bell way down

The Question is what
causes the wheel to
permit Audion to
amplify 6 Vibs per sec
an intermittent Current of
a few hundred a second
or no thermo but the mirror.

Current intermitted (12) ~~[illegible]~~

Each wave of the 6 per second broken up into hundreds of waves –

Putting in Phone + 4 row with a straight Current through 100 000 – no mirror Current Phone at Mirror load from wheel. ———

Plain wheel now + phone plain wheel demagnetized

Throw only 4".

Wheel Sounds very much reduced – (12) less thermo Current –

looks as if it needed 1000 or more waves per second to carry the slow 6 vibs sec loads from phone, & perhaps it would strengthen the 100 or more per second when we listen in on the water tube,

2500 per second steady would let talker on phone as resonance would cut it out anyway

We stop break wheel & put in a Reg phone in circuit with phonoplex, & start a phonograph with music on — This doesn't

give any thrill to speak of
on the Mirror from
6 Vibs of the phonoplex

It seems to want several
hundred ~~[illegible]~~ tracks
in the 6 Vibs themselves
+ in addition the same
number of tracks in a
current stronger than
the phonoplex

Since thermo current
from track will is
practically gone on
account of coiling

Wheel with Mercury
We are filling in
Cement with the
Wheel a German Silver
iron Thermo Couple
heated over chimney
of an Outside Kerosene
lamp — The Wheel
will supply the breaks
the thermo couple supply
the Current + the Phonoplex
in front of Pulleys
Wheel Carrying the 4
iron segments Insulated

Note, of Chin Lout work with various strengths of Thermo Currents

Then the best results were got from wheel by the enormous increase of voices due to good contact,

Possibly it would work to agitate the grid or perhaps the iron of the transformer

by a Disc motor would supply the 6 vibrations note — The thermo current helps the Mirror 5 or 6" Mirror Thermo above lamp too variable, will put one end in water —

Note — Without Audion or Break wheel. the phonoplex set at 1" get $3\frac{1}{2}$ — With Audion + without wheel have to put phonoplex

to within $\frac{1}{4}$" of inch
to get $3\frac{1}{2}$ lbs oil—
showing actual loss.
instead of amplifying

604

We start fresh —

Phonoplex one from the revolving
Rubber wheels Mirror not
shunted, No wheel or
Thermio — Phone at Mirror
in Concert Cant hear anything
Except slight whistling in
Accelerator —
All running every few seconds
Whistling on Accelerator
Suddenly increases —
When it does so spot
jump 10 or more inches

These apacms are 15 seconds apart.

Tuned up to 175 Mil amp nothing — Then tuned down to 18½ Mil

Not a sign of tuning.

Even at ¼" phonoplex away 37 Mil amp hear phonoplex then phone only when mirror jumps off scale —

We now move phonoplex away from Rubber wheel 7" Epof dont move + there is no wobbling or jumping of Audion

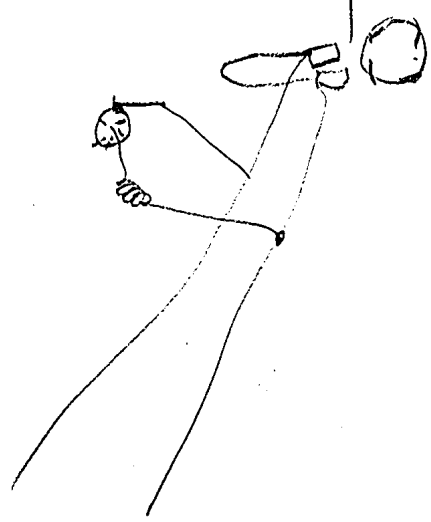
but we get nothing —

We start wheel, which has
been cleaned of Mercury
phonoplex 1" away
+ wheel running get
5" throw — stop
wheel get nothing
hear wheel when
running loud in
Mercro phone, showing
phonoplex is giving
loud sound but no
amplification over
street cement.

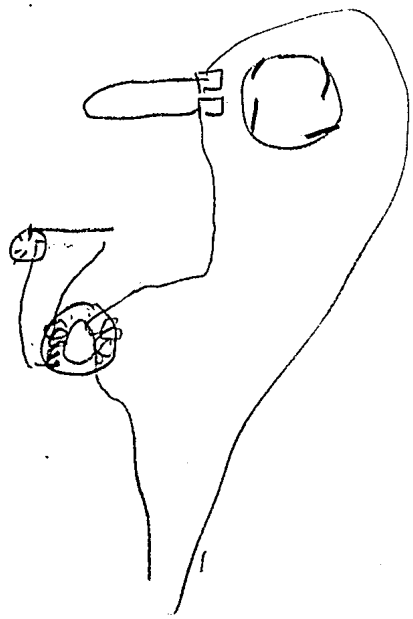
Note –

I guess wheel dont give thermo, its the current from the phonoplex that broken up into sound & yet the high note amplifies but the 60 V.d waves dont amplify to give the throw right.

300 ohm in phonoplex current wheel swung $1\frac{1}{4}$"



We multiple arc the wheel with — ohm in the current just hear wheel mirror throw 1/2" + less

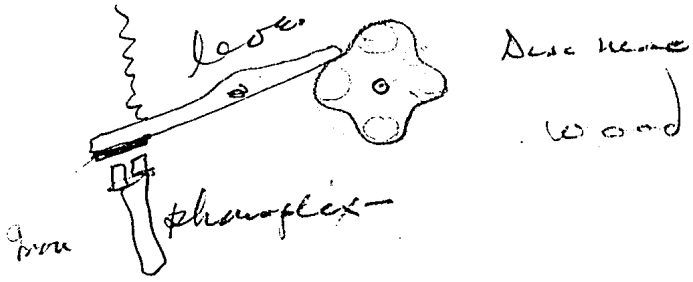


We hear faintly the wheel
showing ~~[illegible]~~ some
Thermo/Current.

12 Midnight – Cannot get amplification by capacity across mirror, either a phone or 5 Mf Condenser or Earth – or phone in series or Condenser

Have concluded that our Rubber Wheel with iron across does not give a wave that can be tuned. We now cut out a cam wheel to be put on phonograph giving movement to a lever on the end of which is a piece of

Iron in front of the phonaplex - This should give a true wave



5 All - finished Cam wheel =
Phonaplex set 1" away from lever iron when it is nearest to the phonaplex 5/8 Iron

The Audion out Tuned
gives at time 8" but varies
on account of friction on
which, varying the speed
of phonograph, Milliamps
on Detector, 38.2 —
Giving 1" — 37 milliamps on
detector,

Hear it in phone at Mirror
with Audion in —
Very strong at 12 inches
away of phonoplex —
+ ~~not~~ Light continuously
thrown into Opening,
but Speed of Disc Varies
so much Out Tune —

in addition Audion Kicks
with static

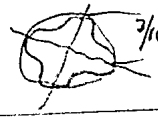
Monday - Telephone Audion
Expert came at 6 pm -
found no way of amplifying
not Coew as good as direct wire
finally We made up one
Audion, He use 40 Mf
Condensor ~~[illegible]~~ & multiple
used 3 Audion Lamps
with this We get at
1" away ~~of~~ phonaplex
from Rubber Cam
wheel 14" Wrong

which is amplification
of $3\frac{1}{2}$ times — at $1\frac{1}{2}$
away of phonoplex
got 2 inch throw —
Also. Cut out phonoplex
put a Bell phone right in funnel
of Cylinder phono &
listened by another
phone, it was very
weak but I could hear it
Bill put at another Then
it amplified I should
say $3\frac{1}{2}$ times also
But I noticed it forced

Mirror somewhat on low notes of Beethoven funeral March, especially where there is a pause

We now connect up another section with only 1 lamp as Expert says that all that necessary on 2nd stage as major work comes on final stage

The Wooden wheel is out 3/16



3/16 shutter thumbscrew

Direct 1" away 4 inches.

14" 1" away

3½ times — 2" 1½

Second condition —

3.5
5
17.5

10" 1½ away —

3½ 2" away

17½ times amplify

When the 2nd stage is in
It went to 10 inches when
phonaplex set at 1½
and 3½" when set
at 2" away.

Put a Mica diaphram on
face of Rubber Wheel
got about same throw
of Mirror as with
sheet ~~tin~~ on and ~~when~~ Bell
phone was 1½ away
While the was on
Expert Made a change
in Audion & got
several inches throw

When ~~the~~ a bell
phone held 2 ft away

This change made by
Expert enormously
increased the
amplification as
far as our ears is
Concerned — We now
put back the iron
on lever + try it as we
originally had it.

This only gives 4"
throw at 2" away
showing improvement of

1/2" by the change
the improvement of the
other way was due to
knock of the Rocker on
wheel —

After an hour ~~put~~
~~[illegible]~~
tried again but
Auction Kicks
Cant do anything at
2" away — Hurry Hero —
War in Hell — The sound
of some German meat
have got into the Auction
Backs —

I am very quiet as power started & you know
We start this gun
with a lot of new
apparatus connected
with the audion

13

Wednesday Night

Brass 4 wave wheel – Duet 4"
When phonoplex 1" away

Two audions 1" away 16" swing
" 1½ " 4½
" 2" " 1

An attempt to put 3rd audion
on. Waves, badly when phonoph

Scriven says

1 audion multiplies effect to 2
2 " " 8
3 " " 32
4 " " 128

Assuming we got 4" throw on Mirror direct without audion with 4 audions we should get 128" comparatively speaking

Stopped, now trying find out trouble,

---

5 am - got 3/4" throw with 3 audions - using 120 Volt Lalande 17/cell Quart dry cells only Best so far done, it's steady - Phonoplex 3" away Director 37.1 Milamp

this with - U18

With U7 10 mag Director 65 Milamp. nearly double - Phonoplex 3" get 1" to 1 1/2" throw

Make 400 more Lelande cells -

As the audion is now quite steady the steadiness of the Lelandes helps - Wants more of them think U18 is preferable -

I note that U7 is very much more sensitive to shocks than U18 - as U7 has twice number of needles perhaps its due to greater weight

Now we put in U16 -
Dimitar at 28 ml amp gives 1" throw, Hirakes same
Thomaplex - 3" away
Hard Rubber Bobbin been used lately 350 ohms

phonoplex 3" away
We put in the High
Resistance — B2066in
of Mercro — Dont improve
think the 350 Cool Cent

[ITEMS(S) FOUND IN BOOK]

U19 3/16 mirror 5 needles — fibre
stretched with 1 gram
Mirror .005 needles .005

U 20 Duplicate of this
but stretched with
2 grams
Mirror .005 needles .005

U 21 Duplicate above
with 1/2 gram same as
no. but instead of
9/32 total length of fibre
use 5/32 —
Mirror .005 needles .005

U. 2. U. 9. U. 13 have been changed